

Serial No. 09/840,359  
February 5, 2004  
Reply to the Office Action dated November 6, 2003  
Page 2 of 10

This listing of claims will replace all prior versions, and listings, of claims in the application:

**LISTING OF CLAIMS:**

Claims 1 and 2 (canceled)

Claim 3 (currently amended): A surface acoustic wave device in accordance with claim 16, wherein said piezoelectric thin film contacts at least one of said substrate and said comb electrodes at the negative surface thereof.

Claim 4 (currently amended): A surface acoustic wave device in accordance with ~~any one of claim 16~~, further comprising a short-circuit electrode disposed on said piezoelectric thin film.

Claim 5 (currently amended): A surface acoustic wave device in accordance with claim 16, wherein the Euler angles of said quartz substrate are within the range such that the power flow angle PFA of a Rayleigh wave is within about  $\pm 2.5^\circ$ .

~~Claim 6 (currently amended)6. A surface acoustic wave device in accordance with claim 1. A surface acoustic wave device, comprising:~~

a quartz substrate;

a piezoelectric thin film disposed on said quartz substrate;

comb electrodes disposed between said quartz substrate and said piezoelectric thin film; and

the normalized film thickness  $H/\lambda$  of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is H, and the wavelength of a surface acoustic wave is  $\lambda$ ; wherein

the Euler angles of said quartz substrate are within the range such that the

Serial No. 09/840,359  
February 5, 2004  
Reply to the Office Action dated November 6, 2003  
Page 3 of 10

temperature coefficient of frequency TCF of the surface acoustic wave device is within about  $\pm 25$  ppm/ $^{\circ}$ C.

Claim 7 (original): A surface acoustic wave device in accordance with claim 6, wherein the Euler angles of said quartz substrate are within the range such that the temperature coefficient of frequency TCF of the surface acoustic wave device is within about  $\pm 5$  ppm/ $^{\circ}$ C.

Claim 8 (currently amended): A surface acoustic wave device in accordance with claim 46, wherein the Euler angles of said quartz substrate are within the range such that the electromechanical coupling coefficient for the Rayleigh wave,  $K^2$  is not smaller than about 0.8%.

Claim 9 (previously presented): A surface acoustic wave device comprising:  
a quartz substrate;  
a piezoelectric thin film disposed on said quartz substrate;  
comb electrodes disposed between said quartz substrate and said piezoelectric thin film; and

the normalized film thickness  $H/\lambda$  of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is  $H$ , and the wavelength of a surface acoustic wave is  $\lambda$ ; wherein

the Euler angles of said quartz substrate are within the range such that the power flow angle PFA of a Rayleigh wave is within about  $\pm 2.5^{\circ}$ ; and

the Euler angles of said quartz substrate are within the range such that the electromechanical coupling coefficient for a spurious wave  $K_{sp}^2$  is not larger than about 0.05%.

Serial No. 09/840,359  
February 5, 2004  
Reply to the Office Action dated November 6, 2003  
Page 4 of 10

Claim 10 (currently amended): A surface acoustic wave device in accordance with claim 46, wherein the temperature coefficient of frequency, TCF of said piezoelectric thin film has a negative value.

Claim 11 (currently amended): A surface acoustic wave device in accordance with claim 46, wherein the Euler angles of said quartz substrate are within the range such that the difference in the power flow angle,  $\Delta\text{PFA}$  between the surface acoustic wave to be utilized and the unwanted surface acoustic wave not to be utilized is within about  $\pm 1^\circ$ .

Claim 12 (currently amended): A surface acoustic wave device in accordance with claim 46, wherein said piezoelectric thin film is made of a material selected from the group consisting of ZnO, AlN, Ta<sub>2</sub>O<sub>5</sub>, and CdS.

Claim 13 (currently amended): A surface acoustic wave device according to claim 46, wherein the angle  $\phi$  of the Euler angles  $(\phi, \theta, \psi)$  is within a range of  $-35^\circ$  to  $+35^\circ$ .

Claim 14 (previously presented): A surface acoustic wave device, comprising:  
a quartz substrate;  
a piezoelectric thin film disposed on said quartz substrate;  
comb electrodes disposed between said quartz substrate and said piezoelectric thin film; and

the normalized film thickness  $H/\lambda$  of said piezoelectric thin film is at least about 0.20, wherein the film thickness of said piezoelectric thin film is  $H$ , and the wavelength of a surface acoustic wave is  $\lambda$ ; wherein

Serial No. 09/840,359  
 February 5, 2004  
 Reply to the Office Action dated November 6, 2003  
 Page 5 of 10

the Euler angles of said quartz substrate are within a range such that the power flow angle PFA of a Rayleigh wave is within about  $\pm 2.5^\circ$ ;

said range of the Euler angles set such that the PFA is within about  $\pm 2.5^\circ$  is within an area surrounded by lines which are represented by the following equations:

$$\theta = 201.77292 - 8.1909\psi + 0.3257\psi^2 - 0.00532\psi^3 + 0.0000286691\psi^4 \text{ and } 3 \leq \psi \leq 40;$$

$$\theta = -2.3333\psi + 221.33 \text{ and } 40 \leq \psi \leq 43;$$

$$\theta = -20.667\psi + 1009.7 \text{ and } 43 \leq \psi \leq 44.5;$$

$$\psi = 242.92932 - 2.46296\theta - 0.04285\theta^2 + 0.000792121\theta^3 - 0.00000316309\theta^4 \text{ and } 60 \leq \psi \leq 106;$$

$$\theta = 60 \text{ and } 28 \leq \psi \leq 70;$$

$$\theta = 1.39744\psi^2 - 78.37179\psi + 1158.8 \text{ and } 27.5 \leq \psi \leq 32;$$

$$\theta = 9.8429 + 15.55204\psi - 1.0153\psi^2 + 0.0306\psi^3 - 0.00038175\psi^4 \text{ and } 3 \leq \psi \leq 32;$$

$$\theta = 60 \text{ and } 0 \leq \psi \leq 4;$$

$$\psi = 0 \text{ and } 60 \leq \theta \leq 180;$$

$$\theta = 180 \text{ and } 0 \leq \psi \leq 4; \text{ and}$$

the Euler angles of said quartz substrate are within a range such that the electromechanical coupling coefficient for a spurious wave,  $K_{sp}^2$  is not larger than about 0.05%;

said range of the Euler angles set such that  $K_{sp}^2$  is not larger than about 0.05% is within an area surrounded by lines which are represented by the following equations:

$$\theta = 461.5 - 51.23992\psi + 3.55894\psi^2 - 0.12153\psi^3 + 0.00171\psi^4 \text{ and } 12 \leq \psi \leq 25.5;$$

$$\theta = -10\psi + 425 \text{ and } 24 \leq \psi \leq 25.5;$$

$$\theta = -88.97104 + 38.79904\psi - 1.80561\psi^2 + 0.03334\psi^3 - 0.000217323\psi^4 \text{ and } 27 \leq \psi \leq 43;$$

Serial No. 09/840,359

February 5, 2004

Reply to the Office Action dated November 6, 2003

Page 6 of 10

$\theta = -0.013928594\psi^4 + 2.255507173\psi^3 -$   
 $136.803833233\psi^2 + 3684.063042727\psi - 37024.00$  and  $33 \leq \psi \leq 43$ ;  
 $\theta = 0.0009461088154\psi^4 - 0.178399621211\psi^3 + 12.5950972795403\psi^2 -$   
 $395.999782194768\psi + 4763.57$  and  $33 \leq \psi \leq 55$ ;  
 $\theta = 60$  and  $29 \leq \psi \leq 55$ ;  
 $\theta = 0.01724063\psi^3 - 1.20723413\psi^2 + 24.63357158\psi - 58$  and  $16 \leq \psi \leq 30$ ;  
 $\theta = 0.0139\psi^2 + 0.9028\psi + 79$  and  $79 \leq \psi \leq 100$ ;  
 $\psi = 0$  and  $78 \leq \theta \leq 180$ ;  
 $\theta = 180$  and  $0 \leq \psi \leq 13$ ;  
 $\theta = 180$  and  $24 \leq \psi \leq 29$ .